ALFALFA SEED GROWING AND THE WEATHER, IN UTAH.

By J. CECIL ALTER, Meteorologist.

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SYNOPSIS.—The first crop of alfalfa is usually cut for hay in Utah, and the second crop is allowed to go to seed. The seed crop should have sufficient moisture during its early growth to produce a vigorous, healthy plant, but the weather should be dry and not too warm while the plants are in bloom. The dry spell must not be too extended, however, as the seed must have sufficient moisture while setting to give it size and weight. Definite comparisons with yield in Utah show that the spring temperature should average from 3° to 5° F. a day above the normal, and from 2° to 4° F. a day below the normal during the summer months, for best results.

It takes nearly twice as long to grow and mature a seed crop as it does a hay crop. Seed is usually ready for harvest in Utah one to two weeks in advance of the average killing frost date.

As a temperature of 26° to 28° F. in the foliage will seriously damage partially ripe and unripe seed burrs, the frost and minimum temperature forecasts at seed harvest time are of especial importance. The usual practice is to cut as large an area as possible on the receipt of frost warnings, but as the first cold period is often followed by several weeks of fine ripening weather, and as the value of the seed is said to increase at the rate of nearly $5 an acre each 24 hours when ripening, efforts should be made to protect the plants from frost damage without cutting.—*J. W. S.*

To every alfalfa grower comes the question, Shall the crop be cut for hay or left for seed? To the central and eastern States grower it arises but rarely, while in the interior western third of the United States, where the altitude, aridity, sunshine, and summer warmth are especially favorable for seed development in average years, the question is perennial.

Owing to the great demand for seed, its production is imperative whenever meteorological conditions will permit, the climate being the limiting factor generally, and the current weather being the major control affecting any season's yield. When droughty conditions threaten the life of the alfalfa plant, nature aims to prevent the destruction of the species apparently by the prolific production of seed; it is not produced in large quantities under other conditions.

Seed crops are matured more or less regularly in all parts of the United States, excepting the extreme eastern coast, but the certainty of the crop and the security of the industry are greatest in the plateau States. A crop is grown in the Central States principally when the corn crop fails, due to drought, the yield running from 2 to 3 bushels per acre as a rule. In the interior western States yields ranging from 4 to 6 bushels per acre on the average, and as much as 8 to 10 bushels over wide areas, are produced about 4 seasons out of 5 as a rule.

The general conditions of soil, topography, and climate in the seed producing regions of the West are very similar to those of the established seed producing regions of the Old World, and it must be assumed from the exacting demands of the crop that seed growing can not be regarded as a stable industry outside of such areas. The failures of the crop in Utah, for instance, which is a leading seed producer, are due principally to grasshoppers and weevils, though such accidental causes as shortage of irrigation water, excessive rains, desiccating winds at blossom time, and untimely spring or autumn frosts are sometimes reported.

Alfalfa, when considered for seed, should have an abundance of precipitation until near cutting time of the first hay crop; the second growth, which is usually the seed crop, should have a moderate supply during its early growth, or just sufficient to produce a vigorous, healthy plant; there should be no heavy rains thereafter until the bloom has fallen. A very favorable normal distribution of precipitation occurs in Utah, where the season is wet until the end of May, and quite dry thereafter, thus giving the first growth of alfalfa sufficient moisture to produce unlimited development and growth of the root system, and provide the necessary physical vigor for bringing on the seed crop. More especially, however, does this heavy spring precipitation provide a storage of moisture in the soil for the early use of the seed crop.

There must be a rapid and early rise of springtime temperatures, without setbacks, to get the first or hay crop out of the way and get the seed crop started off in good season. Such seasons have produced yields above the average usually, especially if the ensuing summers were moderately cool and not too dry. Deficient yields have very frequently been associated with late, backward springs and much wet weather.

The summer drought, along about seed setting and ripening time, must not be too severe, as there must be ample moisture to fill the seeds out and give them weight. Also, heavy rains must not wash away the pollen, neither must rainy periods interfere greatly with the work of bees. If the yield is dependent on natural precipitation, studies made in Utah would indicate that 2 or 3 inches of precipitation a month from March to May, inclusive, are desirable, with about one-half an inch per month, thereafter in light showers.

The summer must not be too warm at blossom time, as the wilting and blighting of the bloom are readily accomplished by sustained high wind and a deficiency of moisture occurring inopportunely. Average monthly maximum temperatures above 90° (F.) in the months of blossoming are unfavorable; and a short period of temperatures about 100° F., when moisture is deficient, have resulted in light yields.

Broadly speaking, the month in which alfalfa starts its growth in spring, should have a mean temperature normally of about 40° (F.); about 48° (F.) in the next month for best development; 56° (F.) in the next month; and about 65° (F.) in the month during which the first hay crop is taken, these being approximately the optimum figures prevailing in the Utah seed regions. They are for March, April, May, and June. The crop matures in months of similar temperatures but of different name, in both cooler and warmer climates generally.

The seed crop follows in months with mean temperatures, which are considered approximately the optimum, of 70° (F.) to 75° (F.), in July and August, these being the blossoming and seeding months in Utah. Statistical studies show that this period may be followed by either warmer or cooler periods, for the work of harvesting, though if the mean temperature of the following month, September, be 60° (F.) or lower, there is a strong probability of frost damage before the average harvest is completed. Definite comparisons with yields in several years and localities show that mean spring temperatures from 3° to 5° above normal in Utah are necessary for securing a yield of seed above the average, in regions where there is normally but scant time to mature a good crop of hay and its subsequent seed crop, between the average dates of spring and autumn killing frosts. Such spring seasons should be followed by summers from 2° (F) to 4° (F.) below normal, to give a slow and gradual plant growth, and a consequent better and more extensive setting of the seed.

Studies of killing frost data show that the seasons are longer and safer on the gently sloping or foothill lands than in the broad open flat lands, the increase in the length of the summer frost-free season amounting to from two to three weeks. Also, that the actual altitude, within certain limits, exerts less influence on the average frost dates than the immediate surface configuration or topography.

The most favorable altitudes in Utah for seed are from 4,300 to 5,500 feet above sea level, where the second crop is saved for seed. Above 5,000 feet on the broad open plains where frost formation is not retarded by air movement regularly, the seed crop must be started off very promptly to escape the average dates of autumn frosts. At altitudes of 5,500 to 6,500 feet, where seed is usually grown from the first cutting, the starting of the seed crop is regulated by close pasturing frequently. The starting of the second crop for seed may be regulated by the time of cutting the first crop, and all development and cutting dates can be forced or delayed somewhat by withholding or applying irrigation water and also by proper cultivation to conserve moisture while in stubble stage.

The average cutting dates vary with the accumulations of excesses or deficiencies in temperature—that is, with the amount of the retardation or advancement of the season in any year. This is determined by adding the daily temperature departures from normal daily. The average maturing season for the principal seed producing regions in Utah is about 80 days, the first cutting coming about June 15 to 20 in average years. Forty days are then required, as a rule, to reach the early blossom stage or cutting time for hay, about July 25 to 30. Forty additional days in an average year for maturing the seed brings the harvest about September 4 to 9, a week or two before the average date of first killing frost in autumn. It takes a little longer to mature at the higher altitudes and in cooler seasons, but an excess of moisture is much more potent in prolonging the growing season.

Grasshoppers are usually more numerous in the fields during a droughty season, when feed elsewhere is scarce; and weevils are more predatory in late spring seasons, when it is cold and wet. The weevil may be very successfully combated by cutting the first crop as early as may be necessary and working the field energetically with brush and wire drags and other implements, if the weather is dry, to bury the larvæ. If the weevil is not thus covered in the dust mulch the seed crop will probably be retarded as much as several weeks, depending on the amount of moisture and the quantity of the weevils. If the spring be greatly retarded, and much loss of hay would result in an early cutting, heavy pasturing may be substituted, or spraying with solutions of arsenate of lead or zinc arsenite, as recommended by the United States Bureau of Entomology officials in Utah.

To avoid or mitigate injury from the occasional early autumn frost, in case the seed is still in the field at this time, as is often the case in Utah, the commonest practice is to cut all the seed practicable upon the issuance of the frost warning and irrigate such fields as may not be ready to cut and as have water available. The partially ripened seed will mature after cutting, though since it is adding many pounds per acre per day in weight and improving steadily in quality, only those portions of the non-irrigable fields most subject to frost should be cut. In the pile, shock, or windrow there are fewer seed pods exposed to the frost; though those that are exposed will be injured about the same as if left standing. The practicability of cutting seed prior to frost was first stated in Utah by Mr. George McCune, of Mills, Utah, now special meteorological observer, who, as spokesman for a number of growers, requested the first alfalfa seed frost-warning service, which was begun in 1913.

The use of irrigation water to ward off frost injury or formation has been fairly well demonstrated in many fields and seed regions, and is rapidly growing in favor, wherever the water is available. Some growers conserve water for this special use by withholding some that might be applied a short time earlier to make the seed fill out properly. In all cases the ditches must not be allowed to become useless and every effort made to provide a little water for use on the afternoon or evening prior to the expected frost in the fields which can best be irrigated or which are most retarded in growth. The watering will prolong the growing season and retard the ripening of the seed somewhat, but it usually makes a greater number of pounds in the yield, and, by warding off a light frost, the quality is undoubtedly improved.

Early autumn frosts are very often followed, in Utah, by several weeks of fine weather, at least enough time in which to mature and harvest the seed crop, therefore every effort must be made to protect the crop against this first frost. The probability is that the first frost will not be as severe nor as hard to combat as the later frosts.

There has been some experimental smudging, that is, producing a small amount of heat and a great deal of a smoke and steam or moisture blanket to prevent the loss of heat by radiation, by burning wet straw or manure along the windward side of large seed areas; and in view of the certain amount of success of this form of protection for the fruit orchards of California, Oregon, Idaho, Ohio, parts of Utah and other States, the practice warrants every possible consideration in the alfalfa seed growing regions, especially where it can be made a community affair.

Every effort has been made to correlate the weather conditions in the Utah alfalfa seed growing regions with general conditions shown on the daily weather maps from which the daily weather forecasts are made by the district and national forecastser, for the purpose of amplifying these forecasts for the several individual localities, and for estimating as accurately as possible the probable minimum temperature that may be expected on the following morning.

Special meteorological stations are maintained in a few places, where the need has seemed to be greatest, from which weather reports are received by telegraph daily at Salt Lake City from the time the first ripe seed appear until the last has been harvested. The State forecasts and the amplifications are made available at government expense to every seed growing region where the growers wish to make use of them.

Cooperative weather stations are located conveniently to practically all the seed producing regions of the State, and thus the climates of these regions have become more or less familiar, through the Bureau's publications. The special alfalfa seed region meteorological Station at Deseret, Utah, in charge of Mr. Samuel W. Western, for the past five years (see figs. 1, 2, and 3), shows that temperatures in the alfalfa foliage, in which the special station is located, is about 3° cooler on the average than in the ordinary weather station exposure such as Mr. Western has had on his farmstead for the past twenty years. On cloudy mornings the temperature in the alfalfa foliage will not differ greatly from that in the ordinary thermometer shelter. In general, the colder it is the greater has been the difference between these readings; that is if the general temperatures are in the lower forties the difference will be less than if general

values are in the lower thirties. When temperatures of slightly above freezing occurred in the regular cooperative station, temperatures 6° or 8° lower have occurred in the special station shelter in the alfalfa foliage.

A thermograph has been exposed in this special alfalfa station, as shown in the accompanying photograph, from the records of which the duration of the cold has been determined. This does not vary greatly from the hourly march of temperature and the duration of both the high and the low temperatures as shown on thermograph records at Salt Lake City, so far as the records have been obtained for study. The principal feature of this, however, is that the cold occurs just prior to sunrise, and that the damaging values are usually of rather short duration. Hence smudging as a frost prevention need not begin until toward morning, nor need it continue long, the time being dependent entirely on the temperatures recorded in the region at the time. In general, on a clear night, when a minimum temperature of 25° (F.) is reached, the thermograph shows that the temperature was below 30° (F.) not to exceed two hours. This value, however, varies somewhat on different nights, depending principally on the amount of clouds and wind. Temperatures of 32° (F.) in the foliage have resulted in some damage; temperatures of 30° (F.) usually cause considerable damage.

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